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THE HORN SPEAKER

Happy Holidays

Reinartz, Cockaday and the Super Tri[illegible]n

A look into history: early broadcast receivers and how Amateurs adapted them to their use

BY PAUL C. CRUM, W9LC

Most Amateurs who've joined the ranks since 1930 will wonder why a story on the development of the radio broadcast receiver would be of interest. This may be particularly true of those who've been licensed since 1970. With the world full of ICs, microprocessors, and transistors, it may seem that such an article would be an excursion into ancient history. But to many of those who lived through the early days of radio it seems that only a knowledge of "where we've been" can establish a basis for understanding the developments that came later.

This is a history of the development of the early tube-type radio broadcast receiver. It describes how these early sets evolved into Amateur-band receivers and presents some interesting sidelights on how the problems associated with early communications receivers were solved by pioneers with ingenuity and perserverance.

The close ties between amateur radio and broadcasting during the early 1920s are illustrated by the fact that radio receivers, both commercial and composite, were designed to be used in both services. For example, an ad for the 1922 Tuska Type-222 Standard Receiver, "Wavelength 150 to 800 Meters," claimed: "It is recommended for the beginner or semi-experienced operator who desires a high-grade complete outfit for radiophone or C. W. (*sic*) and spark code reception." Many years passed before receivers were marketed that were designed primarily for Amateur service. And the earliest of those were designed also to be used on the broadcast band.

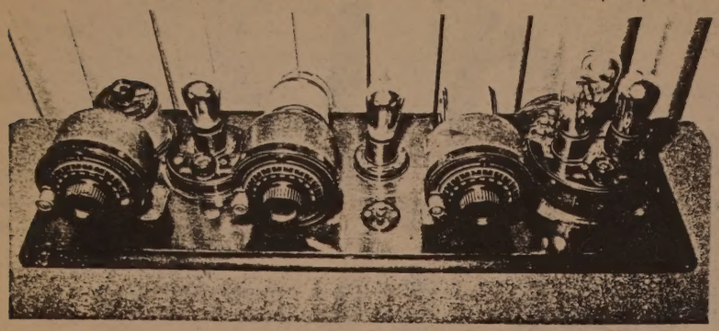
The tuned circuit

Many of the early discoveries have survived and are still in use. The superheterodyne is an outstanding example of these. Although its oscillator may be tuned by devices other than large variable capacitors — conceived of sixty years ago — the superhet is still with us and probably always will be. Many other early developments occurred in amateur radio or were due to the work of amateurs. For instance, the system of tuning transmitting and receiving circuits to resonance was developed by amateurs. Originally, transmitters were completely untuned; their frequencies were determined by their antenna-circuit characteristics.

Commercial manufacturers were slow to incorporate new ideas into their equipment. They continued for some time with untuned circuits. It was believed at that time that the longer wavelengths provided greater distance communications, thus Amateurs began to add coils in their transmitter antenna circuits to increase the wavelength. Amateurs also discovered that optimum results could be obtained by varying the inductance, when it was used in receiving circuits, to resonate their receivers with the transmitters to which they were listening. This was first done with a sliding contact on the coil wire.

Although many feel that tuning didn't arrive until 1908, tuned circuits had been used in a number of instances before that date. A Clapp Eastham loose coupler in my collection bears a Marconi Company patent notice dated 1903. As

Atwater Kent 5-tube broadcast receiver — the famous breadboard (1924).



with many other ideas (the superheterodyne, for instance), the theory was known a number of years before it came into practice. In a few cases untuned transmitters were used much later than this. My collection includes a portable spark transmitter that was used in the trenches during World War I in which no tuning whatever is used. The antenna was connected directly to one side of the spark gap and the counterpoise was connected to the other side.

The Amateur and broadcast radio

Early Amateurs are familiar with the development of the radiotelephone, which appeared in 1906, and with the completely unorganized legal tangle that was "early radio." In fact, the earliest broadcasting was by Amateurs, and a few commercial stations that had radiotelephone capability, for the amusement of themselves and their rather limited audience.

Dr. Lee De Forest was one of the very early broadcasters. He transmitted program material in 1910. Members of the *Radio Club of America* used an arc radiotelephone to broadcast music to the fleet in the Hudson River in 1911. Although several stations claimed the honor of being the first to broadcast regular entertainment, it's believed that the first to do so on a regular basis, similar to present-day organized broadcastings, was Frank Conrad at Station W8XK. He began transmitting music rather than code on November 2, 1920.

The system of transmitting program material that came to be known as broadcasting burst upon the American scene within a very short period. During the latter part of 1921 hundreds of radiotelephone stations were broadcasting music. These included innumerable Amateur stations. On any given evening, one could meditate to the soft strains of *Sweet Hour of Prayer*, or be regaled by *Who Put the Overalls in Mrs. Murphy's Chowder*. In January of 1922 the Department of Commerce, which was the agency regulating radio at that time, temporarily amended Paragraph 57 of its regulations to forbid the broadcasting of program material by Amateur stations.

Pertinent to the discussion of the development of radio broadcast receivers is the fact that, at that time, all broadcasting stations were limited to a wavelength of 360 meters for entertainment material and to 485 meters for market reports and weather forecasts. A short time later The National Radio Conference assigned broadcasting stations wavelengths between 310 - 435 meters. This rather narrow range explains the somewhat restricted tuning capabilities of some of the receivers discussed later.

Broadcast transmitters of the period were extremely simple in design and operation. Many operators at these stations used them for both services. After the broadcast station signed off, their transmitter frequency was shifted to the Amateur band, and the station transmitter became the transmitter for Amateur operation. Usually this required no more than retuning the tank capacitor of the self-excited oscillator, which was the rf transmitter section, and possibly retuning the antenna slightly.

The regenerative receiver

As mentioned earlier, receivers were often designed for, and used in, both services. With the coming of CW, receiver requirements became more stringent than they had been for receiving spark signals. This was because it was necessary to have regenerative receivers in an oscillating mode to copy CW signals. Their tuning was, of course, very sharp in this mode. This problem was further aggravated by the instability of amateur transmitters of the period. Large amounts of frequency drift were common, and short-term frequency shift was pronounced because of varying line voltages and power supplies with poor regulation.

The inventors. Mention of the regenerative receiver requires including two of the real giants of early radio — and how their paths crossed in an unhappy manner. Although the basic information given here has been covered many times in many publications, it's surprising that one aspect hasn't been often discussed.

Dr. Lee De Forest, of course, made the whole area of vacuum-tube receivers possible with the invention of the triode tube. The entire industry was founded on his discovery. Major Edwin Armstrong was the other individual whose contributions to early radio were of enormous value.

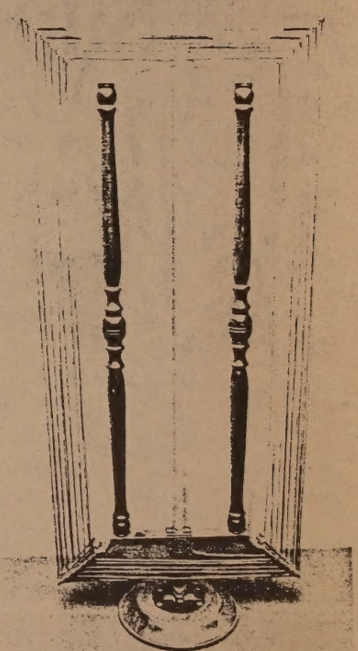
Major Armstrong is generally credited with having discovered, while a student at Columbia University, the principle of regeneration. He was issued a U.S. patent for this discovery on October 6, 1914. Not often mentioned is that Dr. De Forest, while working on telephone circuits, also discovered the regeneration principle; a sketch of his circuit appears in his notebook of 1912. At almost the same time (although probably slightly later), young Armstrong discovered this principle and set about using it practically.

Long and bitter litigation followed. This litigation resulted in the appellate court in Washington ruling in De Forest's favor in 1924.

In attempting to evaluate the merits of the work of these two men it seems to me that Dr. De Forest actually discovered the principle first, but with equipment operating at audio frequencies. He didn't do much to put it into practical use. Armstrong's work was with equipment operating at radio frequencies where it would have practical application. Armstrong applied the principle to both transmitters and regenerative receivers.

Some regeneration was automatic in early triode tube rf circuits because only enough in-phase feedback to overcome the internal resistance of the circuits is required to make such an amplifier oscillate. Although this is automatic to a degree, Armstrong's discovery of the practical principles of regeneration made possible oscillators that were both more vigorous for transmitters and controllable for receivers.

Taming the regen. Regenerative receivers were very sensitive but had two serious faults. The first was that they were effective radiators, which caused great interference to other radios in their neighborhood. This was particularly annoying when they were tuned to a station to



Bodine-Chicago loop antenna. Does your TV set use "rabbit ears" for an antenna? Here's its grandpa, used by many early broadcast listeners in the 1920s.

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which someone close by was already listening. The second fault was their critical tuning. They whistled if in an oscillating condition when tuning in a station. Additional arresting effects were produced if, after having been tuned to zero beat with the desired station, tuning began to drift. First announced by a low gutteral growl, the pitch soon rose to a high squeal as the drift continued. Quite a variety of outside influences might trigger such a receiver into this undesirable condition. These ranged from body-capacitance effects, produced by moving one's hand in relationship to the oscillating circuit, to changes in the antenna circuit.

Of the several systems that were used to control regeneration in early broadcast-band regenerative receivers, the most common used a "tickler coil" in the detector plate circuit. Various combinations of cylindrical, honeycomb, and spiderweb coils were used in making tuners, which included this coil in their construction. In some circuits, a variometer was included in the detector plate circuit, as in the popular "one-variocoupler, two-variometer" circuit. This form of regeneration was effective and provided smooth control. The next most common control was a potentiometer, sometimes in the plate but usually in the screen of the detector tube, to vary its voltage. The control in the screen of the early National Company SW-3 receiver detector was known to all hams.

Development of the regenerative circuit. The use of the regeneration control in early receivers made it possible to use them in an oscillating condition to copy CW or, in a nonoscillating condition, for broadcast reception, which permitted tuning without the annoying squeals. Since many early receivers used some form of plug-in or tapped coils to cover a wide range of wavelengths, it was desirable for hams to have receivers for both services.

A form of "double regeneration" is of academic interest but didn't attain wide use. It was promoted by the Buell Coil Company of Chicago. In this circuit, a regenerative rf stage was used ahead of the regenerative detector. By keeping regeneration below the point of oscillation, great amplification could be obtained.

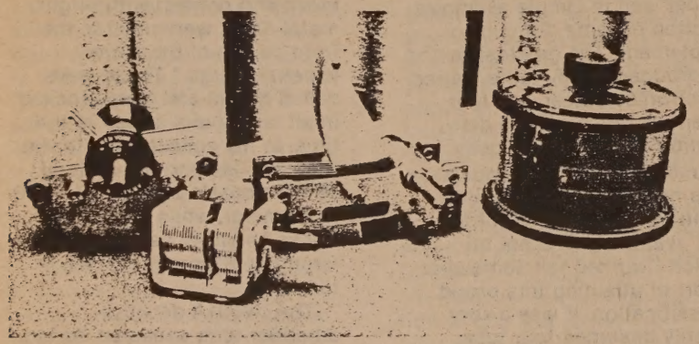
Another circuit, which unquestionably was the invention of Armstrong but didn't attain much success in broadcast receivers, was the super-regenerative. This was the accepted circuit for early vhf reception. It had excellent sensitivity but barn-door selectivity, which was an actual benefit in copying the self-excited oscillator vhf phone rigs of those days. I used it in an early 5-meter transceiver during the 1930s.

Aerola Senior 1-tube farm set (*circa* 1922). Packaged in a beautiful walnut case, the set boasted "portability — easily carried about — put into operation in just a few moments."

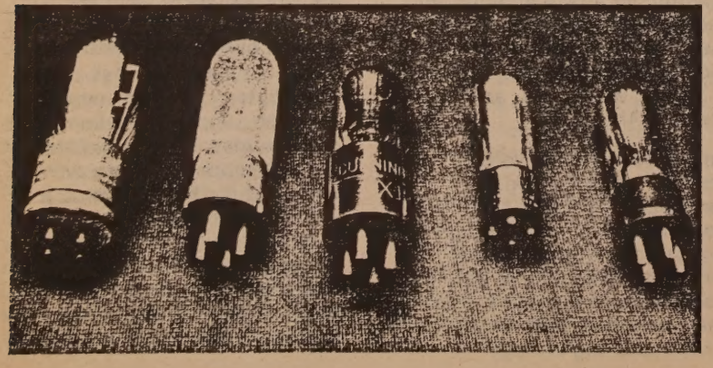
The first regenerative circuit specifically designed to provide receiving stability for CW in the Amateur bands was designed by John Reinartz, which made him famous in early radio circles. Although it could do nothing about the undesirable features of the transmitters, the circuit provided at least a partial solution to the problem of unstable receivers. A broadcast-listener public, somewhat gadget-happy in orientation and seeking new ideas, embraced the Reinartz circuit. Components for this circuit were widely sold in kit form, almost always with a spiderweb coil that was used as the inductance.

Probably the second most popular special regenerative circuit for the broadcast wavelengths was the Cockaday. Designed by Lawrence Cockaday, this circuit claimed great selectivity. In an unusual arrangement, the antenna was coupled by a one-turn coil to another coil, which was in turn inductively coupled to the detector grid. It provided a sort of cascaded tuning for greater selectivity due to the semi-aperiodic tuning, and the antenna length had little effect on the tuning — as opposed to most other circuits in use at that time.

Variable capacitors (or "condensers") for tuning the receiver. In the background are an early "low loss," straightline plate, and a 1914 Murdock 43-plate. A small variable used in today's tube-type superhets is shown in the foreground for comparison.



Early receiving tubes: UV201, WD11, CX12, UV199 and UX199. Filaments were operated from storage or dry cell batteries, which were sometimes camouflaged in a varnished wooden box mounted beneath the radio set.



The rf amplifier

Radio-frequency stages, frequently untuned and providing little gain, were sometimes used ahead of the detector to prevent radiation from regen receivers. These stages were later tuned and provided enough gain for usable sensitivity without resorting to regeneration.

Taming the rf stages. The main problem brought about by adding rf stages was to make them nonoscillating. Atwater Kent was one of early radio's most successful showmen in this regard. His company began by making components. But he hit on a circuit idea that established him as one of the leading manufacturers of the period. Recognizing the fact that an amplifier will oscillate if it has sufficient feedback and enough stage gain to overcome internal circuit resistance, Atwater Kent placed fixed resistances right at the rf-amplifier grids. The resistances were just large enough to reduce stage gain to prevent oscillation. Sensitivity was low, however. These sets were popular for their ease of tuning and freedom from squealing.

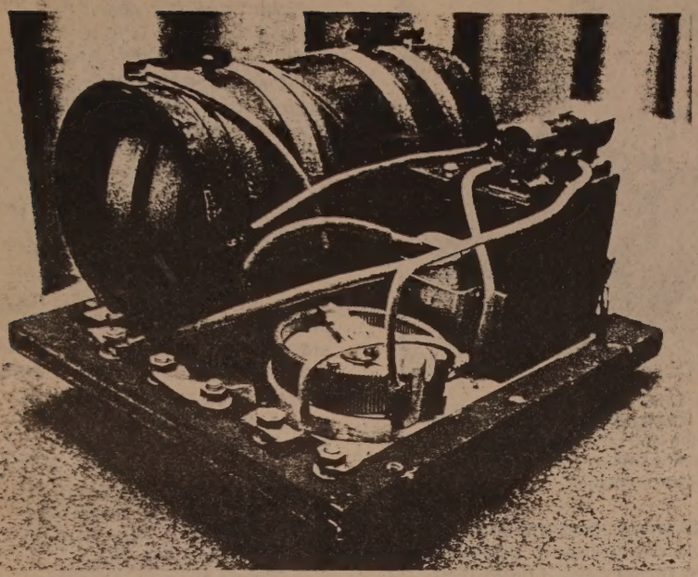
Neutralizing. Before the advent of the screen-grid tube, which made nonoscillating rf amplifiers possible, the method of preventing oscillation was "neutralizing." Professor L. A. Hazeltine found that it was possible to eliminate oscillation in the rf stages by using a small capacitance approximately equal to the internal capacitance of the tube in an rf stage, and a small amount of inductive feedback phased to balance the feedback in the tube and its circuit. Some of these receivers were very hot. Among sets in my collection, a Fada 5-tube Neuterodyne is extremely sensitive.

An aligning procedure used in these sets is interesting. A tube with an inoperative filament was inserted into the socket of the stage to be neutralized, and a small neutralizing capacitor was adjusted for minimum feed-through signal from a test oscillator to indicate neutralization.

The Reflex circuit

In the early days of radio all sets were operated from batteries, so economy of A, B, and C batteries was an important consideration. Many systems were tried to reduce battery consumption. A few used rf amplifiers feeding a crystal detector followed by an audio amplifier. Because of sensitivity loss, the only real benefit from this circuit was the elimination of the tricky regenerative detector with its squealing. It was never used extensively.

One circuit, called the Reflex circuit, became rather successful. In this circuit the number of tubes was reduced by using the same tubes for both rf and audio amplifiers. Crystal



Rear of Aerola Senior showing inductive tuner and rotor construction. Rheostat controlled filament voltage.

detectors were used in early models, but vacuum-tube detectors soon replaced them. The innovative Crosley Company produced a three-tube model, called the Trirdyn, which combined *both* regeneration and reflex principles. This set was very sensitive and had smooth regeneration control, which made it very popular.

Since practical fixed-crystal detectors were not available until the start of World War II, the difficulties produced by the crude models of that time can be imagined. As with all other such detectors of the period these required frequent adjustment and were erratic in operation.

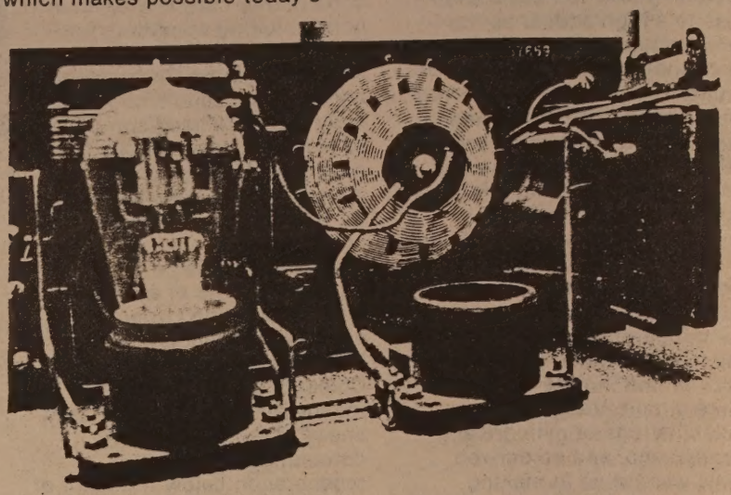
The superhet

The superheterodyne was the culmination of years of experimenting to find the ultimate circuit for receivers. As mentioned earlier, the principle of the superhet was developed by Major Armstrong while in France during World War I. It didn't gain wide acceptance for several years and became popular, for those who could afford it, in the early twenties.

The principle of gang-tuned rf stages had not yet been developed, so the local oscillator and mixer circuits were tuned individually. No rf stages were included ahead of the mixer mainly for the same reason. The oscillators in early supers were powerful radiators. Without preselection they caused great interference to neighboring listeners. Partly to reduce this interference and partly because supers were thought to be sensitive enough not to require outdoor aerials, indoor loop antennas were usually used. Very low frequencies were always used for intermediate frequencies. The image response on the 10-meter Amateur band of an i-f system operating below 100 kHz would be interesting to contemplate! The i-f transformers were gigantic and were strung along the chassis rear in an imposing row. They combined to make a super of that period a device wonderful to behold.

Early tuners and inductances. Rear row, left to right: Atwater Kent variometer, three-circuit tuner, De Forest three-coil mounting and honeycomb coils, and Atwater Kent variocoupler. Front row: Plug-in coil from National SW-3 and basketweave low-loss coil for the rf stage of a tuned radio frequency set.

Tuning problems. Before ganged tuning had been perfected it was necessary to tune the capacitor of each stage individually. Standard practice was to tune the detector stage until the signal was audible then peak each of the two rf capacitors. Ganging, which makes possible today's standard practice of single-dial tuning, was done by splitting the end plate of a variable capacitor into several sections. Each section was bent to increase or decrease the overall capacitance at several spots on the dial. This made tracking with other stages in the set possible.



Rear of Crosley model 51 economy 2-tube set showing booktype variable capacitor, spiderweb coils, and coupling-varying system.

Although this system was simple in theory and worked rather well in simple examples, it often became difficult to implement. The greatest period of drudgery in my rather varied electronics career was that spent at "aligning and gain testing" at the old Grigsby Grunow plant in Chicago. It was here that the set called "The Mighty Monarch of the Air" was built. The set on which I worked fell somewhat short of attaining this proud classification. It was a very hastily designed four-tube multiband receiver. The multiplicity of bands, combined with less-than-perfect components from which it was constructed, made aligning the tracking and sensitivity at the low end of the broadcast band a job requiring a combination of genius, sheer luck, and help from the Almighty.

Early tubes. Battery voltage drops as batteries approach discharge. Therefore, tubes for these early sets were designed with rated filament voltages lower than the rated voltage of the batteries from which they were to be operated. This permitted using storage batteries for filaments until they were almost discharged. Commonly, "6-volt" tubes were actually rated to be operated at 5 volts. These tubes were designed to be operated from 6-volt storage batteries, standard in most automobiles at the time.

The two receiving tubes commonly used in the earliest days were the UV200 and the UV201. They consumed a full ampere of current on their filaments. While producing a modest amount of sound, these tubes produced a large amount of light, which illuminated early sets quite dramatically. To obtain full eye value from the receivers, screened circular holes, covered with a fine wire mesh and rimmed with bright metal rings, were used in the front panels of the more expensive sets.* These were called bezels and were stocked in all radio parts stores at the time. In my collection both the Kennedy 110 and the Federal 59 have bezels 25.4 mm (1 inch) in diameter, while the RA-DA Tuner Amplifier has a single large one 51 mm (2 inches) in diameter.

The UV201A detector-amplifier tube appeared during the spring of 1923. It greatly reduced filament current, operating at only 0.25 ampere. This tube was the standard of the industry for several years. Its introduction made possible the use of multitube sets such as the 5-tube tuned rf and the superheterodyne. Dry-battery tubes to supply the radio needs of countless farms, which had not yet obtained a-c power, appeared in 1923. The first, a WD11, was operated from a single 1-1/2-volt "telephone" battery. Its filament was rated at 1.1 volts and drew 0.25 ampere. RCA used thousands of these tubes in a series of

sets designed for the farm trade.

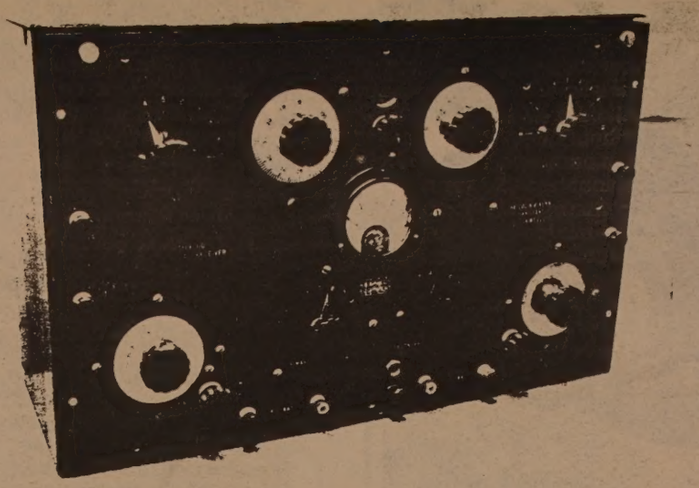
Originally a one-tube set, the Aerola Senior, used this tube. The receiver came in a beautiful walnut case with the panel flat-mounted on its top. It looked as if it had been lifted from a physics laboratory. It had a protective lid, which could be lowered, and even had a picture of the set in the lid to show how to connect it to its accessories. An early Montgomery Ward radio catalog listed this set as being "portable." It stated that the set was so compact and light in weight that it could "easily be carried around, and because of its simplicity, it could be set up and put into operation in just a few moments."

The ad emphasized that one had only to use a "dry telephone battery, a B battery, a pair of headphones, and an antenna outfit" to make up the entire set. Although touting it for outdoor recreational purposes, the ad did not mention how a hundred people on a picnic could listen to it at one time on headphones or how the aerial was to be erected when using it in a canoe. Later models of these sets were called Radiolas. Their familiar Model III, a two-tube set, and the Model III-A with four tubes, and a push-pull audio output stage, brought radio to thousands of farms.

Variable capacitors

They were always called condensers in those days and came into service during the early 1900s. A Murdock 23-plate variable in a round transparent case with Bakelite end plates in my collection dates from 1914. Machinery to build variable capacitors was intricate and expensive, so various methods were tried to avoid using factory-built variables. Unassembled variables were sold, affording a tangible saving to the builder. Since I ranked very near the bottom of the economic ladder in those days, my first variable capacitor was so constructed.

The Crosley Company was to early radio what Ford was to the early automobile industry. Their sets were designed basically for economy, although later more elaborate models were made to sell at higher prices. One innovation the Crosley Company used in their lower-priced sets was a "book type" variable capacitor. It was a model of simplicity and bore no resemblance to current variables. Earlier models were made of wood, but later models were made of a composition material. It had one fixed vertical frame holding a copper plate. Another hinged plate held a second sheet of copper. A cam on the end of the shaft that extended through the panel to the dial caused the movable plate to alternately clamp against the stationary plate, then move away from it, thus varying the capacitance. The overall capacitance was increased by the simple expedient of having a sheet of mica between the two plates. It was advertised as being "usable for even low-power transmitters."



The classic Colin B. Kennedy model 110 receiver (*circa* 1922). It covered 175-25,000 meters. A 2-stage audio amplifier was also available. The set was a magnificent example of the craftsmanship used in those days. A mint-condition model 110 would command a very substantial price today.

Variable capacitors in those days were sometimes very large. My Kennedy 110 uses two gigantic capacitors with plates 102 mm (4-inches) in diameter and assemblies 178 mm (7-inches) in depth. The capacitor has two groups of 11 plates on each shaft. To balance their weight they are divided with their plates 180 degrees from each other.

The grouping of stations at one end of the dial was later resolved by changing the shape of the rotor plates from semicircular to one with the tips of one end of the rotor plates projecting farther from the center. These were first called "straightline wavelength" capacitors; later they were called straightline frequency capacitors.

The variometer and other early inductors

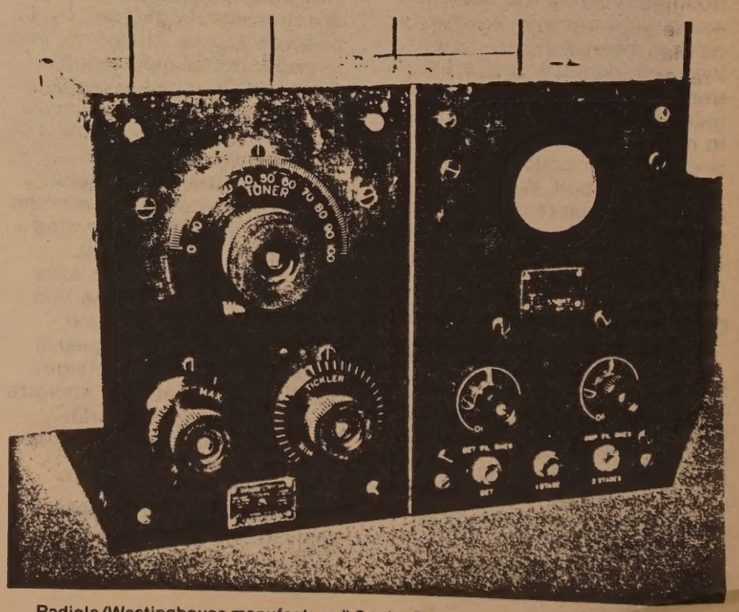
With the coming of the broadcast era, except for occasional crystal sets, the slide tuners and loose couplers that had been the standard tuners of earlier radio were abandoned for more sophisticated and elaborate tuning systems. In the days of regenerative sets these tuners usually took the form of variocouplers or variometers. Both of these used a coil that rotated inside a larger fixed coil. Although the rotors were usually similar, the variocoupler frequently used a fiber tube for its primary, while the variometer used either a molded Bakelite housing or one made from flat blocks of wood.

As their name implied, variocouplers were basically for coupling — frequently between antenna and tube grid circuit — while the variometer was used for tuning or in an oscillating-detector plate circuit to control regeneration. The two variometer windings were connected in series so they would either add or "buck" as the rotor was turned. These devices came in a variety of configurations. In the more expensive units, molded Bakelite was usually used for rotors (and the stators of variometers), while the more modest models used turned-wood spheres for their rotors. On these variometers the stator coils were wound inside large flat wooden blocks.

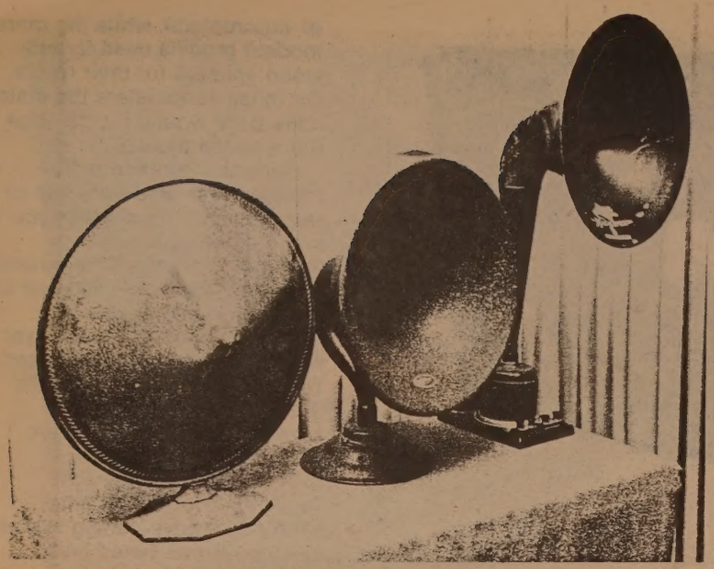
Common items in radio stores at the time were kits of wooden parts from which you could make your own variometer. Commercial tuners of the molded type used one or more rotors. To enable very long-wave operation multilayer windings were frequently used. The Kennedy Model 110 used this system. With this arrangement it covered from 175 to 25,000 meters!

The Westinghouse R.A. Tuner built for the broadcast band had a novel tuning system in which it was tuned both inductively and capacitively by the same dial. The variable capacitor and variometer were connected in series. Advertising stated that they were "so balanced that rotating one shaft changes simultaneously the inductance and capacitance of the antenna circuit, thereby keeping the efficiency of the oscillating circuit practically constant throughout the entire range of the receiver." In another unusual arrangement regeneration was controlled by a tap switch on the tickler winding.

The spiderweb inductor. Two other types of coils in common use were the honeycomb and spiderweb. Spiderweb coils were of interest mainly because of their low cost and ease of winding. A "spiderweb" disk of cardboard, slotted to hold the wire, formed the inductance of many early receivers. Some commercial manufacturers, such as Crosley, used these coils in



Radiola (Westinghouse manufactured) 3-tube RA-DA tuner-amplifier (*circa* 1922).



Early loudspeakers: the Crosley Cone, Atwater Kent horn type, and Magnavox R-3 field-coil horn speaker.

their low-priced units. In an economy move typical for this company, the coupling between the two spiderweb coils was varied in a simple "come to me, go from me" arrangement in which one coil was slid nearer to, or farther from, the other on a square rod. Other manufacturers sometimes mounted them to hinge "book-style" to vary the coupling.

The honeycomb inductor. For those who could afford them, honeycomb coils represented the ultimate, especially if it was desirable to cover a wide range of wavelengths, many of them very long. Of the several companies that manufactured these coils, De Forest was one of the outstanding. It made a three-coil mounting for the popular circuit that used one coil in the antenna, the second in the detector grid circuit, and the third in its plate circuit to produce and control regeneration. While some manufacturers used levers to move their coils in swinging-door mountings with handles, De Forest used an intricate gear arrangement, with knobs on its front, to move the two outside coils and vary their coupling to the fixed center coil. Wound on tubing 25.4 mm (1 inch) by 51 mm (2 inches), honeycomb coils were compact and offered great flexibility.

Early audio circuits

The audio-output circuits of early vacuum-tube sets were designed to work into high impedances. Headphones were used before enough amplification was available to operate loud speakers. It was easy to make headphone windings of high-enough impedance to match the output of one-tube sets. This remained standard practice even after audio amplifiers were used to boost output.

When this output became great enough to operate speakers, amplifier output was fed directly to the high-impedance speaker windings. The speakers were in the amplifier-tube output circuits and carried tube B voltage. It was a simple system but had some disadvantages. In addition to a tendency toward dc saturation, occasional burnouts occurred in the speaker windings.

Another difficulty in early speaker design was to obtain sufficient flux density. Before the arrival of materials such as Alnico V, speaker magnets were large and flux density was very low. The magnets were horseshoe-shaped with moving coils placed between their poles. Several manufacturers attempted to overcome this inadequacy by manufacturing "field-coil dynamics" using an electromagnet energized by a local dc source. Magnavox was a leader in this area, using a field coil designed to operate from a 6-volt storage battery. No appreciable improvement in low-frequency reproduction appeared until the field-coil magnet was combined with the cone diaphragm. This mating produced the first actual fidelity of reproduction. After ac-operated radios came into being, it became standard practice to place the speaker field coil in the high-voltage lead and automatically energize it while using it for a filter choke. The speaker configuration that used an electromagnet and heavy cone diaphragm resulted in astonishingly natural reproduction, especially in the low-frequency range.

Probably no one part of an early radio installation was more symbolic than the antenna, or aerial as it was called. Graphics of early radio items always included pictures of massive structures, usually composed of four parallel wires strung between two high towers. These imposing structures served two purposes. The first was utilitarian: to pick up the signal. The second was to inform all neighbors that this family owned one of the new "radiophones."

Long discussions ensued over the merits of stranded *versus* solid wire and insulated *versus* bare wire for aerials. These installations usually used a small knife switch to disconnect the aerial from the receiver and to ground it, thus providing a degree of lightning protection.

Among early antenna design ideas was one promoted by Leon Lambert of Wichita, Kansas, for an early crystal set. This set promised great DX but required the use of a single piece of solid wire from 46-61 meters (150-200 feet) long. Absolutely no joint — soldered or otherwise — was permitted, because it was thought that such a joint would add appreciable loss to the installation.

The "hype" — buyers beware!

Only credulous unsophisticated persons would feel that commercial chicanery is a recent development. Although many methods were tried, two were most common and of historical interest. One was a method of "testing" vacuum tubes. Unscrupulous dealers, desiring to sell tubes with low emission, had an arrangement that put a small positive voltage on the grid of the tube under test. Although these tubes weren't usable in circuits requiring appreciable emission, they were frequently usable in rf-amplifier circuits that didn't have to handle much power.

Within reasonable limits, a similar phenomenon is taken advantage of in present-day television transmitters. It was standard practice at one TV station I operated for a number of years to use tubes with slightly failing emission as "aural finals" since in fm service the tubes weren't required to supply the high peak currents used in the a-m video portion of the transmitter. In fact they were often operated satisfactorily even after their emission was reduced to where it was not possible to obtain rated grid current.

Probably the second most common system of taking early customers was the practice of advertising sets as "multi-tubed" but with several tubes having no connections whatever except to their filaments. Many a "seven-" or "eight-" tube set actually had only an untuned rf stage with regenerative detector and two stages of audio amplification. The other tubes contributed nothing more than a slight amount of additional light and a boost to the owner's vanity.

Further reading

Exploring the early days of radio is interesting and gives an insight into how Amateurs have progressed. The following list of suggested articles has been culled from *ham radio* magazine. In it you'll find some easy reading by authors who have been there.

Clemens, Charles W. Jr., K6QD, "Brass Pounding on Wheels," *ham radio*, March, 1975, pages 58-59.
Davies, John D., K4NW, "Those were the Days," *ham radio*, April, 1971, pages 40-45.
Gottlieb, Irv., W6HDM, "Nostalgia with a Vengeance," *ham radio*, April, 1972, pages 28-30.
Marriner, Ed, W6BLZ, "Early Wireless Stations," *ham radio*, October, 1968, pages 64-68.
Marriner, E. H., W6BLZ, "Wireless Point Loma," *ham radio*, April, 1968, pages 54-57.
Marriner, E. H., W6BLZ, "Catalina Wireless 1902," *ham radio*, April, 1970, pages 32-35.
Marriner, Ed, W6BLZ, "First Wireless in Alaska," *ham radio*, April, 1973, pages 48-55.

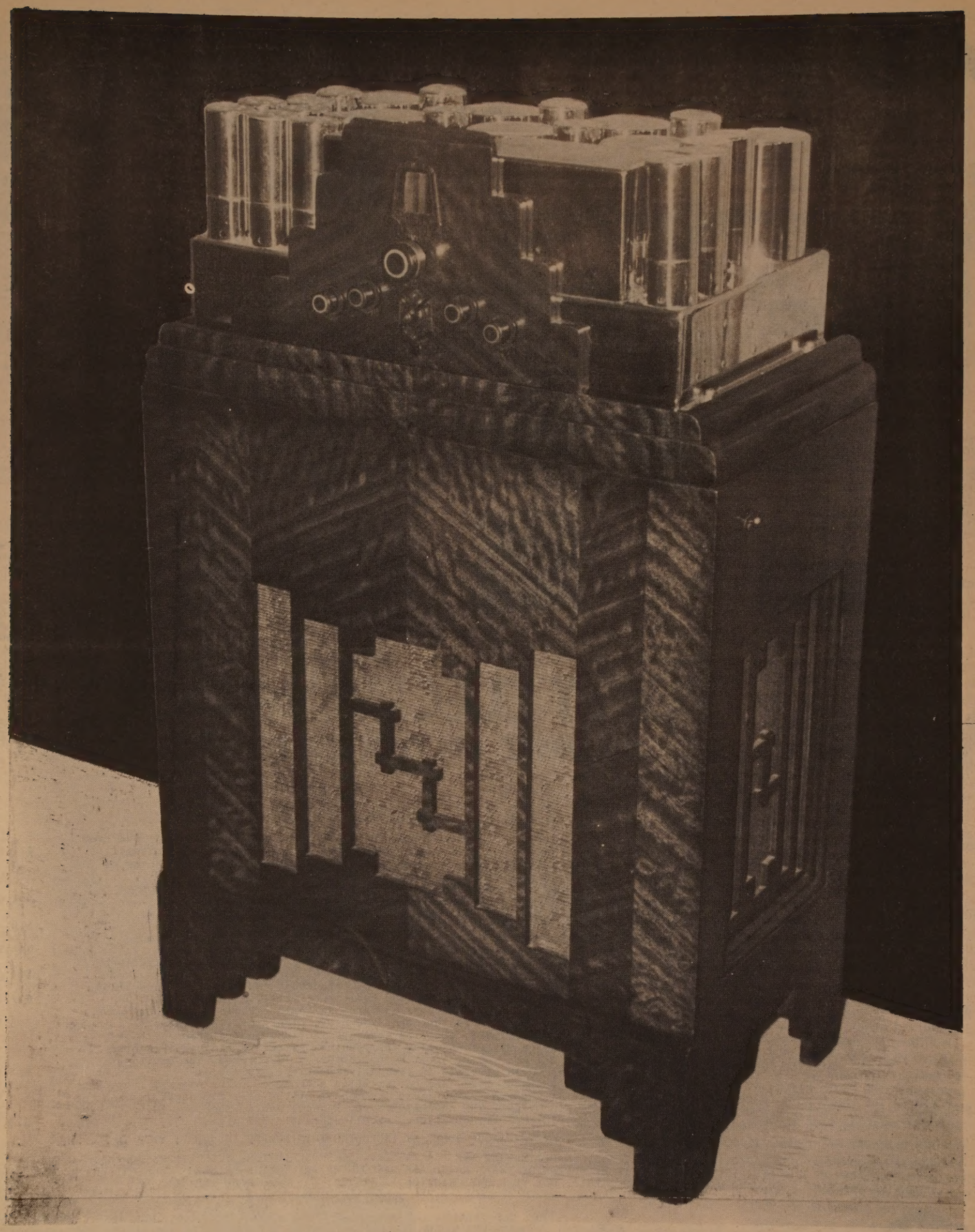
THE HORN SPEAKER acknowledges gratefully full credit to Paul Crum and The Ham Radio Publishing Group for use of the article, "Reinartz, Cockaday and Super Trirdyn, which was originally published, September 1979, in HAM RADIO HORIZONS.

AT THE VRPS CONVENTION

The Vintage Radio and Phongraph Society registered an attendance of 114 at their October Convention. Probably, another 80 attended as visitors.

The auction sales beat their old record with a sale of 405 items, bringing the club, $13,637.50.

Don Maxwell and George Potter rode away with each carrying a big trophy for "Best of Show." George won the trophy with a 1917 Nesco NC240, a modified CN239, It was honored serial no. 1 when it was built. Don won the trophy with a Victor MS phonograph with a beautiful oak horn.



Scott All Wave Imperial, High Fidelity, manufactured about 1930, using 23 tubes. This is one of Steve Chapman's fine radios, which was featured at the Ellis County Museum in Waxahachie, Texas.

TRADE NAME: "Gundlach Crystal Receiving Set."
TYPE: Crystal receiver; no batteries or tubes needed.
CONTROLS: Two.
AERIAL: Outside.
PRICE: Without antenna or phones $6.00.
MANUFACTURER'S NAME: Gundlach Manhattan Optical Company.

TRADE NAME: "Halldorson 5-Tube Set."
MODEL: RF 500.
TYPE: Two radio, detector and two audio.
TUBES: Five.
BATTERIES: Not furnished.
CONTROLS: Three.
AERIAL: Indoor, outdoor.
PRICE: $115.00 without accessories
MANUFACTURER'S NAME: The Halldorson Company.

TRADE NAME: "Hetro Magnetic."
MODEL: 5-H.
TYPE: Two-stage tuned radio, detector and two audio.
TUBES: Five.
BATTERIES: "A" and "B" needed.
CONTROLS: Three.
AERIAL: Outside, inside.
PRICE: $75.00 without accessories.
MANUFACTURER'S NAME: Sidbenel Electric and Mfg. Company.

TRADE NAME: "Hallerio."
MODEL: III.
TYPE: Crystal receiver; no tubes or batteries needed.
CONTROLS: Two.
AERIAL: Outside.
PRICE: $3.00 without telephone receivers or antenna.
MANUFACTURER'S NAME: W. B. Haller.

TRADE NAME: "Halldorson 4-Tube Set."
MODEL: RD 400.
TYPE: One stage of tuned radio, detector and two stages of audio frequency amplification.
TUBES: Four.
BATTERIES: Not furnished.
CONTROLS: Two.
AERIAL: Outdoor, indoor.
PRICE: $75.00 without accessories.
MANUFACTURER'S NAME: The Halldorson Company.

TRADE NAME: "Hallerio."
MODEL V.
TYPE: Crystal detector; no tubes or batteries needed.
CONTROLS: One.
AERIAL: Outside.
PRICE: $5.00 without telephone receivers or antenna.
MANUFACTURER'S NAME: W. B. Haller.

RAN OUT OF ROOM

We did not have enough room to publish more than six of the 1925 radios. We usually have space for a whole page of these radios in an enlarged form. Next month, we plan to have more room for them.

NEW PHONOGRAPH BOOK

There is a new book on phonograph that will be used by collectors to the point of wearing out the pages. It contains much mechanical detailed information in an easy to read style.

Next month, we plan a review of it. It is called THE COMPLEAT PHONOGRAPH. It is published by Vestal Press.

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PCB695 - MODERN RADIO RECEPTION by Charles R. Leutz, 1925, full of schematic diagrams and illustrations and photos of early Leutz equipment! published by Experimenters Information Service, 1925, 337 pages $19.95
PCB696 - ELECTROLYTIC CAPACITORS by P. Deeley, published by Cornell-Dubilieer, 1938, many diagrams, illustrations, photos, excellent text, nearly anything you would wish to know, an excellent reference, 275 pages $18.95
PCB697 - HENLEY'S 222 RADIO CIRCUIT DESIGNS by Norman W. Henley, 1923, schematic diagrams, circuit theory, etc., many crystal-sets, one-tube-sets, all the way through sets with six tubes!, 271 pages, FANTASTIC!!! $18.95
PCB698 - THE BOOK OF WIRELESS by A.F. Collins, 1922, how to make wireless equipment from scratch, full of drawings and illustrations, covers both receivers and transmitters, spark equipment, etc. 222 pages $16.95
PCB699 - RESONANCE AND ALIGNMENT by John F. Rider, 1936, if you have ever wanted a great text with many illustrations on how to align antique radio receivers, this is it!!, absolutely excellent!, 91 pages $12.95
PCB700 - AUTOMATIC VOLUME CONTROL by John F. Rider, 1936, probably the best and most thorough text, easy to understand, on how A.V.C. works and covering nearly all circuitry used in antique radio receivers!, 93 pages $12.95
PCB701 - ALIGNING PHILCO RECEIVERS by John F. Rider, 1937, if you have ever operated an antique Philco with short wave bands, you know how well they can be made to work! This is just what you need, plenty of illustrations! 135 pages . $13.95
PCB702 - THE RADIO GIRLS, ON THE PROGRAM by Margaret Penrose, 1922, exciting teen-age fiction about a group of high-school girls and college boys who team up to solve mysteries using the then new "wireless equipment", these books are very hard to find and original copies are sought after by collectors. The stories are exciting and best of all, they lend an insight into the world of radio in the early twenties!, 201 pages $12.95
PCB691 - THE RADIO GIRLS, AT FOREST LODGE by Margaret Penrose, 1922, another exciting adventure!!, 202 pages $12.95
PCB690 - THE RADIO BOYS, FIRST WIRELESS, 1922, by Allen Chapman, early radio fiction at its best!!, 213 pages $12.95
PCB703 - RADIO SIMPLIFIED, WHAT IT IS, HOW TO BUILD AND OPERATE THE APPARATUS by L. Kendall and R. Koehler, 1925, covers both spark and vacuum-tube equipment, full of illustrations, excellent text!! 301 pages $18.95

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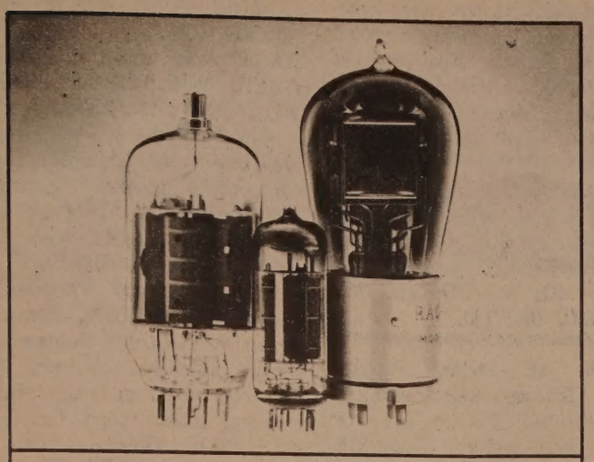

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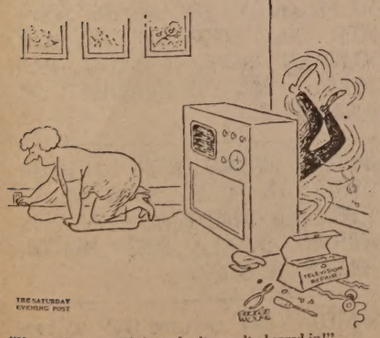

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S.A.S.E. is a self addressed stamped envelope.

WANTED COAXIAL OR TRIAXIAL SPEAKERS of Jensen, Trusonic, Tannoy, Altec 604's. Western Electric equipment (tubes, amps., drivers, horns, speakers, microphones and parts). Radio tubes (50's, 211, 845, 8005) David Yo, P. O. Box 832, Monterey Park, CA 91754. Tel. (818) 576-2642.

CATHEDRAL RADIOS, MUST BE NICE AND WORKING CONDITION. WILL PAY TOP DOLLAR. ALSO WANT OTHER UNUSUAL AC RADIOS. HAROLD PERKINS, 4468 SUN VALLEY DRIVE, LAS VEGAS, NV 89121.

WANTED —— RCA CREDENZA'S, Edison windups - speaker systems and components, JBL Hartfield, Paragons- Altec Laguna, Magnificent, 515A/B, 288B/C, 604B/C/D/E, E.V. Patricians, Tannoy Autograph, GRF - Red/ Silver/ Gold, Jensen G610, Western Electric theatre equipment, speakers, drivers, horns, electron tubes, mixers, x-formers, x-overs, tubes, round top 45, 50 - W.E. 252A, 300A/B, 350B, etc. Charles Dripps, 4331 Maxson Road, El Monte, CA 91732. (818) 444-7079.

WANTED —— GRANDFATHER CLOCK RADIO and Radiola IV. Gordon Wilson, 11108 - 50 Avenue, Edmonton, Alberta, CAnada, T6H 0H9

WANTED— OLD 1960s or 70s large Allied Radio Catalogs. Earl Phillips, 311 David Lane, Maryville, TN 37801.

WANTED: BOOKS; buy, beg, borrow, rent or steal. Twining, "Wireless Telegraphy and High Frequency Electricity;" Curtis, "Construction of Induction Coils & Transformers;" Collins, "The Amateur Electrician's Handbook;" and other books with Tesla coil projects. Need data for forthcoming bibliography. TCBA, RD 3, Box 181, Glens Falls, NY (518) 792-1003.

WANTED- INSTRUCTIONS FOR OPERATING Hickock tube tester model # 600-A plus supplement tube data sheets. Zerox copies OK. Frank Hoffert, 19605 Chardon road, Cleveland, OH 44117. Tel. (216) 481-0226.

WANTED— OLD 1960s or 70s large Allied Radio Catalogs. Earl Phillips, 311 David Lane, Maryville, TN 37801.

WANTED— FOUR WIRE OSC. COIL 266KC or Philco part 322828. Don Aldred, 39 East 8th Street, Jacksonville, FL 32206.

URGENT— URGENT—— NEED PART FOR VOLUME CONTROL FOR AK BREADBOARD MODEL 10. STRIP THAT HAS WIRE WOUND ON INSIDE OF CONTROL. RUSS SCHOEN, R#1, CLINTONVILLE, WI 54929.

WANTED: INFORMATION OR EQUIVALENT CHARTS ON MUTER BRAND BALLAST TUBES. OLD CATALOGS MAY LIST THEM. ANTHONY JACOBI, 8053 MAYWOOD, RALSTON, NE 68127.

WANTED - New or used 0A2 voltage

regulator tubes. Need 1200, must be reasonable. Tom Burgess, Box 9769, Little Rock, AR 72219 - (501) 565-1750 evenings.

WANTED: GRANDFATHER CLOCK RADIO, AK, Philco, etc. Gordon Wilson, 11108 - 50 Avenue, Edmonton, Alberta Canada T6H 0H9.

WANTED: ONE REMLER DRUM DIAL WITH DIAL PLATE. THIS DIAL IS GEAR DRIVEN AND IS ABOUT 4" IN DIAMETER. MUST HAVE A CLEAN DIAL SCALE. WILL PAY $25 FOR A CLEAN COMPLETE UNIT. BOB HERBIG, 4178 CHASIN STREET, OCEANSIDE, CA 92056.

AMATEUR RECEIVERS— GREBE, HAMMARLUND, NATIONAL BRETING, HOWARD, HALLICRAFTER, ALSO EARLY QST'S, HANDBOOKS, CRYSTAL SETS. K4UJZ, 608 W. THOMPSON LANE, MURFREESBORO, TN 37130.

RADIOLA Balanced amplifier— RADIOLA IIIA. whole— parts— junk. State price and condition when corresponding. B. Block, 2118 Winn, Kemah, TX 77565.

WANTED — TWO WINDING OSCILLATOR COIL, 265 kc I.f. frequency badly needed. For sale Thompson flybacks and yokes, two thru 167. $12.95 postpaid. — Don Aldred, 39 East 8th Street, Jax. FL 32206.

RADIOLA ITEMS WANTED: Vocarola, RE, AR, Concert Receiver; Radiola IV, VI, VIIB / IX grand; any of AA series. CASH OR TRADES. Rosenthal, 507 South Maryland Avenue, Wilmington, DE 19804

WANTED: SET OF RIDER MANUALS, Vol. 1 thru 8. Must be realistic price. Michael Sabodish, 11A Matawan Avenue, Cliffwood, NJ 07721. (201) 566-1486.

HR-3 RCA ELECTRON TUBE HANDBOOK. Industrial, receiving and transmitting tube technical bulletins by GE, Sylvania, etc. Nick Tusa, K5EF, 129 Somerset, LaPlace, LA 70068 (504) 652-4904.

WANTED: LARGE HIGH VOLTAGE VARIABLE CAPACITOR. TCBA, RD 3, Box 181, Glens Falls, NY 12801

INFORMATION NEEDED— Who can identify the speaker unit for me on the front cover of THE HORN SPEAKER, May 1986 issue? I also need a base for same with or without driver. All replys acknowledged. Bill Stuber, P. O. Box 153 (406 S. 1st Avenue), Woodward, IA 50276 515# 438-2008.

WANTED: COLORFUL "CATALIN" plastic radios; Fada, Emerson, DeWald, Addison, etc. Top prices paid. Mint condition only. R. W. Oliver, 355 Highwood Avenue, Leonia NJ 07605 (201) 944-0777.

WANTED— ANY McMURDO SILVER ELECTRIC set with or without cabinet. Masterpiece I, II, III, IV, V, VI 14-15, 15-17. Any literature, McMURDO SILER TIMES or FORUM. Magazines. Also 1935- 1939 Zenith consoles. We pickup most areas of U. S. and Canada. Frank and Mary Rasada, 12507 Pinegrove Lane, Cerritos, CA 90701. Days: (714) 951-9591. Evenings: (213) 926-6722, leave message for return call.

WANTED— INFORMATION / DATA on the "SHELDON RADIO COMPANY" that was active in Los Angeles 1925-1931. Ed Sheldon, 656 Gravilla Place, La Jolla, CA 92037.

WANTED: SILVERTONE MODEL 4500A, black plastic table model— only interested in cabinet. Tom Johnson, 215 E. 7th Street, Ames, IA 50010.

WANTED: INFORMATION ON PEERLESS wireless, Milo Bailey, Thomas E. Clark (TECLA), and any other pre 1930 Michigan manufacturers: brochures, ads, articles. photocopies ok. Tips welcomed. Oran Sauder, 316 Wellington, South Lyon, MI 48178. (313) 437-4413.

SPARK EQUIPMENT— Especially 25,000 volts Commercial Spark Condenser, Rotary gap or complete sets. Paul C. Crum, 6272 N. Cicero Avenue, Chicago, IL 60646. 1(312) 282-3033.

WANTED: RADIO CORRESPONDENCE course kits. AC or battery. Leo Teply, geddes, SD 57342.

WANTED: DON'T THROW AWAY THOSE ELECTROMECHANICAL POWER SUPPLIES AND PARTS 6 VOLT AND 12 VOLT VIBRATORS, OZ4's, TRANSFORMERS. CASH PAID OR TRADES. MARVIN ROTH, 14500 LaBELLE, OAK PARK, MI (313) 399-5993.

A GERMAN MADE RADIO. Small table model— working condition. Phone or write. PETERSONS, 3115 North 61st Street, Lincoln, NE 68507. (402) 466-7548.

HALLICRAFTERS SX-88, parts or junker. Gene Mottern, 313 Royal Drive, Kingsport, TN 37663.

WANTED: A.K. BREADBOARD PARTS; antenna coils, type 11 tuner coil-tube unit. detector unit, potentiometers. 3 tube detector amplifier unit, switches, highest prices paid. DeWitt L. Bills, 5237 Upton Avenue North, Minneapolis, MN 55430. (612) 521-7109.

WANTED: LARGE HIGH VOLTAGE variable capacitor. Books and magazines on electricity, medical electricity and wireless telegraphy. Want list available. TCBA, RD3, Box 181, Glens Falls, NY 12801.

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1947	192	R-7
1948	192	R-8
1949	160	R-9
1950	192	R-10
1951	160	R-11
1952	168	R-12
1953	192	R-13
1954	160	R-14
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1957	190	R-17
1958	192	R-18
1959	192	R-19
1960	192	R-20
1961	192	R-21
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1953	192	TV-7
1954	192	TV-8
1955	192	TV-9
1955 Late	192	TV-10
1956	192	TV-11
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1957 Late	192	TV-13
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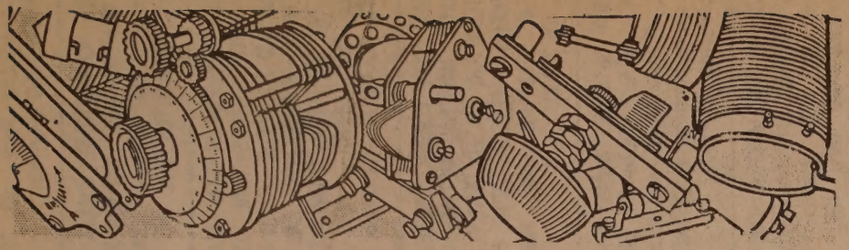

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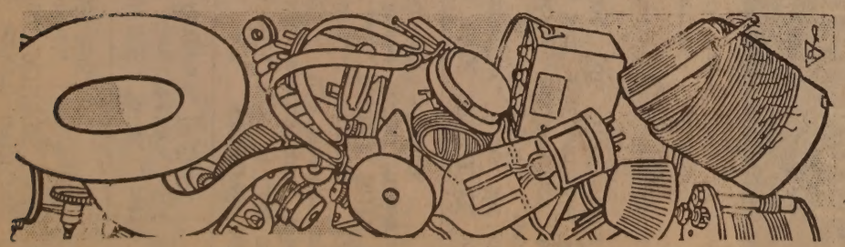

December

THE HORN SPEAKER

1986

STATION 3BQ

Bon Hill, Victoria, Australia

The cover illustration, as shown here, is of a well known amateur short wave station. This is amateur station 3BQ, Bon Hill, Victoria, Australia, which has worked many U. S. A. and English amateur stations. The transmitter is supplied with 1500 volts through an electrolytic rectifier consisting of 104 jars. The tube is a Phillips Z4 operated at a normal plate current of 100 milliamperes. The aerial is a 50-foot five wire cage type suspended between two 80-foot masts. The remarkable work accomplished by this station and many similar stations throughout the world should stimulate the interest of our readers in amateur radio.

3

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